United States Patent

Singer

[15] **3,670,577**

[45] **June 20, 1972**

[54] FLUID SAMPLING APPARATUS

[72] Inventor: **Ernst Singer**, 3491 Puget Drive, Vancouver, British Columbia, Canada

[22] Filed: **March 27, 1970**

[21] Appl. No.: **23,290**

[52] **U.S. Cl.** ..... **73/423 R**, 73/425.4 R

[51] **Int. Cl.** **G01n 1/12**

[58] **Field of Search** ..... 73/421 B, 423

[56] **References Cited**

UNITED STATES PATENTS

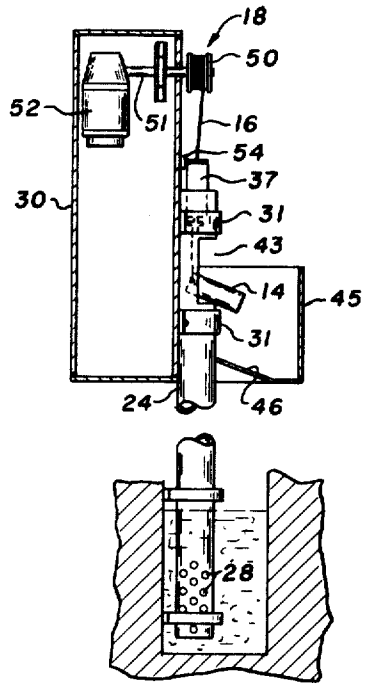
1,494,631	10/1924	Roberts	73/421 B
3,153,345	10/1964	Berg	73/423

Primary Examiner—S. Clement Swisher
Attorney—Fetherstonhaugh & Co.

[57] **ABSTRACT**

Apparatus for taking samples of fluid, such as industrial waste and sewage effluent, including a sampling cup slidably mounted in guide means adapted to extend downwardly in the fluid. Hoisting means lowers and raises the cup, and discharge means at the guide causes the cup to tip and discharge its contents when the cup is raised to a predetermined level. The guide means usually is a tube with the cup slidably mounted therein, and the cup is unbalanced but normally retained in an upright position by the tube. When the cup reaches an opening in the tube this unbalanced state causes it to tip over and discharge its contents.

4 Claims, 11 Drawing Figures



PATENTED JUN 20 1972

3,670,577

SHEET 1 OF 2

FIG. 1.

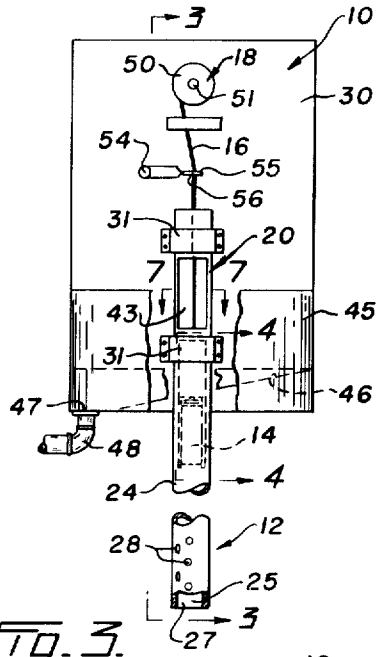


FIG. 2.

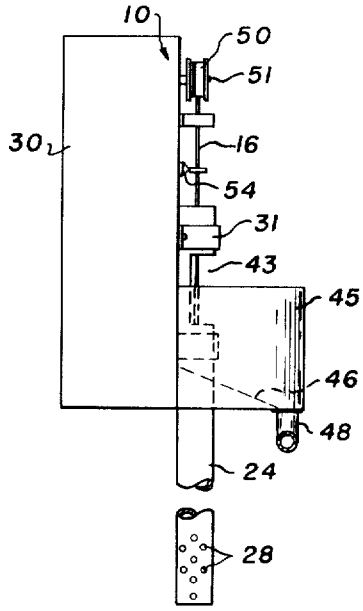


FIG. 3.

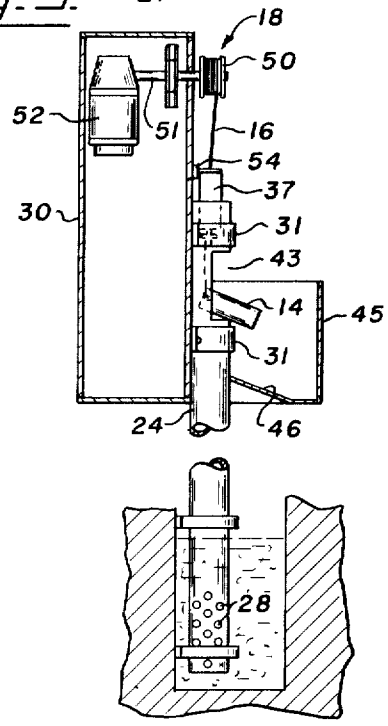
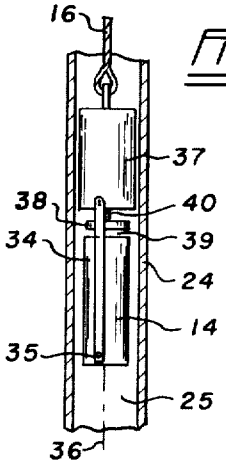


FIG. 4.



INVENTOR
ERNST SINGER
BY
Fetherstonhaugh & Co.
ATTORNEYS

Fig. 6.

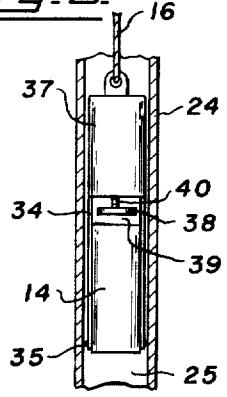


Fig. 5.

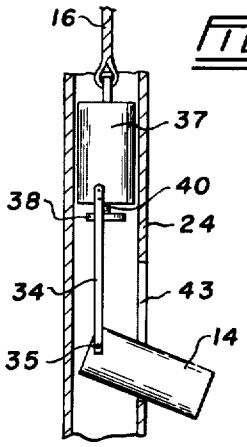


Fig. 7.

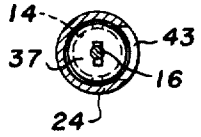


Fig. 8.

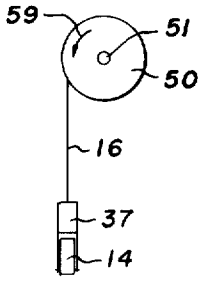


Fig. 9.

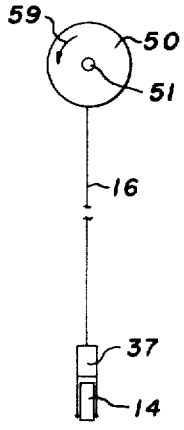


Fig. 10.

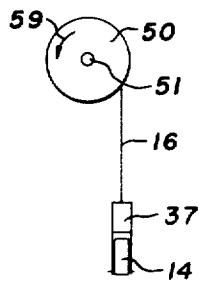
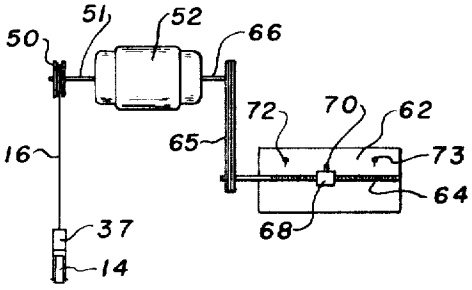


Fig. 11.



INVENTOR
ERNST SINGER
BY
Fetherstonhaugh & Co.
ATTORNEYS

FLUID SAMPLING APPARATUS

This invention relates to apparatus for taking samples of fluid from a body thereof. The sampler can be operated manually, but it usually has a motor for this purpose, and the motor can be operated continuously, or intermittently by suitable timing means.

Samplers of this type are usually used for taking samples of liquids containing solids, such as industrial waste and sewage. The samplers of the prior art are not fully automatic, and usually involve the use of valves, pistons, chains, wheels and pumps which are inherently sources of trouble. It has also been very difficult with the prior samplers to obtain during each time of operation a sample that is representative of the liquid in the body throughout a relatively wide band or depth thereof.

The present fluid sampling apparatus is very simple in construction and operation, can be fully automatic in its operation, and has no sample taking depth limitations. There are no valves, pistons, chains, wheels, or pumps to cause trouble. This sampling apparatus furnishes a true composite representative sample, including suspended solids, and the like. The apparatus does not have to be specially constructed for any particular job or situation, it can be produced in quantity, and the only adjustment needed at the site involves the length of a piece of cable used. The cable is cut in accordance with the depth of the body of liquid, the position of the control mechanism above the liquid, and the depth of the liquid throughout which the samples are required.

Apparatus according to the present invention comprises a sampling cup which is moved up and down in the liquid along guide means by suitable hoisting means. Discharge means at this guide means causes the cup to tip and discharge its contents when the cup is raised to said discharge means by the hoisting means. The guide means is usually in the form of a tube within which the cup slides. The cup is unbalanced in the tube but the latter normally retains it in an upright position. When the cup is raised, an opening in the tube at a desired level permits the cup to tip and discharge its contents. If desired, suitable means can be provided for regulating the flow of liquid into the cup during descent thereof in the liquid.

Examples of the invention are illustrated in the accompanying drawings, in which

FIG. 1 is a front elevation of a preferred form of sampling apparatus in accordance with the present invention,

FIG. 2 is a side elevation of the apparatus,

FIG. 3 is an enlarged sectional view taken on the line 3—3 of FIG. 2, and including a body of liquid to be sampled,

FIG. 4 is an enlarged vertical section taken on the line 4—4 of FIG. 1, with the sampling cup in its upright position,

FIG. 5 is the same as FIG. 4, but showing the cup in its tipped position,

FIG. 6 is a sectional view similar to FIG. 4 taken at right angles thereto,

FIG. 7 is an enlarged horizontal section taken on the line 7—7 of FIG. 1,

FIGS. 8, 9 and 10 are diagrams illustrating a spool arrangement for lowering and raising the sampling cup, and

FIG. 11 diagrammatically illustrates an alternative control means for lowering and raising the cup.

Referring to FIGS. 1 to 10 of the drawings, reference numeral 10 is a preferred form of liquid sampling apparatus in accordance with this invention and including guide means 12, a sampling cup 14, a cable 16 and hoisting means 18. Discharge means 20 is provided at guide means 12 near the upper end thereof.

The guide means 12 is preferably in the form of a tube 24 forming a guideway 25 therein. The guide means can be made in other ways besides a pipe or tube, such as the plurality of rods or bars arranged around a longitudinal center and secured together. Tube 24 preferably has an open lower end 27, and a plurality of vertically arranged openings or apertures 28 near said lower end. There may be several rows of openings 28 in the tube wall all the way around the axis thereof, but if the tube is to be inserted into a flowing liquid, the openings or apertures may be located in the down-stream side of the tube only. The length of the tube depends upon the place where apparatus 10 is to be used. It may be made up of several sections coupled together, or it may be a single section cut to the desired length. The upper end of the tube overlaps a casing 30, and is secured thereto in any suitable manner, such as by one or more clamps 31.

Sampling cup 14 is mounted for vertical movement in tube 24 and normally is in an unbalanced state, but the tube keeps the cup in an upright position. In this example, a yoke 34 straddles cup 14 and is swingably connected thereto near the bottom thereof by pins 35. By referring to FIGS. 4 and 5, it will be seen that pins 35 are located to one side of the vertical center line 36 of the cup. The lower end of cable 16 is connected to the top of yoke 34 in any convenient manner. If desired, the cup and yoke can be made relatively heavy, in which case the cable would be directly connected to the yoke, or a weight 37 can be provided as shown. This weight will slide in tube 24 and cable 16 is connected to the upper end of the weight while the lower end of the latter is secured to yoke 34. The location of pins 35 results in cup 14 being unbalanced so that it would tip relative to yoke 34 if it were not for tube 24 which surrounds the cup.

Although not absolutely necessary, it is advantageous to provide means for regulating the flow of liquid into cup 14. One way of doing this is to provide a rover or disc 38 above the cup. This disc is spaced above the top of the cup to provide an entrance passage 39 through which liquid can flow into the cup. Disc 38 is carried by a screw 40 which is threaded into the lower end of weight 37 so that the disc can be adjusted towards and away from the cup to regulate the size of passage 39. A finer adjustment of the passage size can be obtained by adjustably mounting disc 38 on the upper end of the cup.

Apparatus 10 includes discharge means for causing cup 14 to tip and discharge its contents. In this example, a relatively large opening 43 is provided in tube 24 near the upper end and where it is desired to empty the cup, said opening being large enough to permit cup 14 to swing outwardly therethrough, as shown in FIGS. 3 and 5. During upward movement of the cup in the tube, the cup is normally maintained in an upright position, but when the cup starts to overlap opening 43, there is nothing to keep the cup upright and so it tips outwardly through the opening and discharges its contents. A receptacle 45 is mounted on the front of casing 30 so that tube 24 extends upwardly through this receptacle. Tube opening 43 is so located relative to receptacle 45 that the contents of the cup are discharged into this receptacle. The contents can be removed from the receptacle in any convenient way. In this example, the receptacle has a bottom 46 which slopes down to an outlet 47 to which a pipe 48 is connected. This pipe can extend to a suitable container, not shown.

Although the apparatus described so far can be operated successfully manually by a person gripping cable 16 and lowering and raising the sampling cup within the guide tube, it is preferably to provide power means for doing this, and hoisting means 18 has been provided for this purpose. This guide means includes a spool 50 on which cable 16 is wound, the spool being fixedly mounted on a shaft 51 operatively connected to a motor 52 mounted in casing 30. This is a reversible electric motor, and it is controlled by a reversing switch 54 mounted on the front of casing 30 and extending thereinto. Switches and motors of this type are well known and do not need any description herein, nor does the electrical connection therebetween. Switch 54 has an operating arm 55 which extends substantially horizontally above the upper end of tube 24 and has a small hole 56 therein through which cable 16 extends. A stop is provided on cable 16 to engage and swing upwardly switch arm 55 each time the sampling cup has discharged its contents. In this example, weight 37 is positioned so that it engages the switch arm at the right time. Upward movement of this arm operates switch 54 to reverse the direction of rotation of motor 52.

Switch 54 limits the upward movement of the sampling cup, and the lower limiting of the cup and the changing of its direction of movement is accomplished in a very simple manner without the necessity of reversing motor 52 when the cup is at its lower point. This is illustrated in FIGS. 8, 9, and 10. One end of cable 16 is secured to spool 50, and the cable is of such length that when it is completely unwound from the spool, cup 14 is at the end of its downward travel.

Starting with the cup in its uppermost position, as indicated in FIG. 8, when the spool is rotated in the direction of arrow 59, the cup moves downwardly in tube 24. When the cable is fully extended as shown in FIG. 9, the cup is in its lowermost position, and as the spool continues to rotate in the same direction, the cable is wound back on the spool in the opposite direction, as shown in FIG. 10. This draws the cup upwardly until switch 54 is operated to reverse the motor. If the sampling operation is to continue, this action is repeated, excepting that the spool is rotated oppositely to the direction indicated by arrow 59 so that the cup moves downwardly in FIG. 10. If it is desired to take samples only periodically, a suitable timing mechanism, not shown, would be provided in the motor circuit, in which case switch 54, when operated, would stop the motor as well as reverse it. Then the motor would be energized in response to the timing mechanism to start the next sampling action. As this timing and motor control system is well known in the art, it is not described or shown herein.

The operation of apparatus 10 is very simple, and is obvious from the above. When the apparatus is at rest, sampling cup 14 is in its uppermost position and is tipped outwardly through tube opening 43. When motor 52 is energized either by a manually operated switch or by the timer mentioned above, spool 18 is rotated to unwind cable 16 and thereby permit the cup to move downwardly through tube 24. During the first part of the downward movement, the cup is tipped upwardly by the lower edge of opening 43 into an upright position where it is maintained by the wall of the tube. As the cup moves downwardly through the fluid in which the tube extends, the cup fills during this downward movement and takes samples of the liquids throughout the distance the cup travels while in the fluid. The position of disc 38 relative to the top of the cup determines the rate at which the cup fills and, therefore, the cross-section of the liquid from which the sample is drawn. The fluid has unrestricted flow entry into tube 24, and the eddy currents created therein tend to improve the sample composition. When the cable reaches its full length, it starts to wind back onto the spool, and this continues until the cup reaches opening 43 and tips outwardly to discharge its contents into receptacle 45. At the same time, switch 54 is operated to reverse the motor and if necessary, to stop the latter.

FIG. 10 has been included to illustrate an alternative form of control for motor 52. In this case, the direction of rotation of the motor is reversed at both the upper limit and the lower limit of travel of the sampling cup. The cable 16 is always wound on spool 18 in the same direction, and the lowermost limit of the cup travel is determined by the setting of a switch that reverses the motor and starts the cup moving upwardly again. A well known type of reversing mechanism is illustrated at 62. In this example, a threaded shaft 64 is connected by a sprocket and chain drive 65 to a shaft 66 projecting from motor 52 and which is rotated thereby. A nut 68 is threaded onto shaft 64 and has a finger 70 projecting outwardly therefrom which is adapted to engage and to operate reversing switches 72 and 73 adjacent opposite ends of shaft 64. These switches are electrically connected to motor 52 and are adapted, when operated, to reverse the direction of rotation of said motor. Switches 72 and 73 can be adjusted longitudinally of shaft 64 so as to regulate the length of travel of cup 14 within tube 24.

When motor 52 is energized, spool 18 is rotated to permit cup 16 to move downwardly in the guide tube. When finger 70 engages and operates switch 73, motor 52 is reversed to draw the cup upwardly in the tube. At the time the cup discharges its contents, finger 70 engages and operates switch 72 which reverses the motor and, if necessary, stops it. Suitably timing mechanism may be provided for energizing motor 52 when required.

I claim

1. Apparatus for taking samples of fluid from a body thereof, comprising a substantially vertical tubular guide adapted to be placed in a fluid and opening at its lower end into the fluid, an unstable sampling cup slidably mounted in the guide, a cable extending through the guide and connected at one end to the cup in such a way that said cup at all times remains upright only through sliding engagement with the guide, an opening in the guide spaced from said lower end and large enough to permit the cup when drawn up to the opening to tip therethrough owing to a lack of support by the guide at said opening and thereby discharging its contents, a spool to which the opposite end of the cable is connected, a reversible electric motor operatively connected to the spool to wind and unwind the cable on said spool, the length of said cable determining the distance the cup travels down the guide so that the cup travels down and up without the motor being reversed, a reversing switch operatively connected to the motor, and operating means on the cable, said operating means and said switch being so positioned that the operating means engages and operates the switch each time the cup tips to discharge its contents.

2. Sampling apparatus as claimed in claim 1 in which said operating means comprises a weight connected to the cable above the cup.

3. Apparatus for taking samples of fluid from a body thereof, comprising a substantially vertical tubular guide adapted to be placed in a fluid and opening at its lower end into the fluid, an unstable sampling cup slidably mounted in the guide, hoisting means extending through the guide connected to the cup, said guide normally retaining the cup upright therein, a cover over and spaced from the top of the cup for regulating the rate of flow of fluid into said cup, means for adjusting said cover towards and away from the cup, and an opening in the guide spaced from said lower end and large enough to permit the cup when drawn up to the opening to tip therethrough owing to a lack of support by the guide at said opening and thereby discharging its contents.

4. Apparatus for taking samples of fluid from a body thereof, comprising a substantially vertical tubular guide adapted to be placed in a fluid and opening at its lower end into the fluid, an unstable sampling cup slidably mounted in the guide, a cable extending through the guide and connected at one end to the cup, said guide normally retaining the cup upright therein, a cover over and spaced from the upper end of the cup for regulating the rate of flow of fluid into said cup, means for adjusting said cover towards and away from the cup, a spool to which the opposite end of the cable is connected, a reversible electric motor operatively connected to the spool to wind and unwind the cable on said spool, an opening in the guide spaced from said lower end and large enough to permit the cup when drawn up to the opening to tip therethrough owing to a lack of support by the guide at said opening and thereby discharging its contents, a reversing switch operatively connected to the motor, and operating means on the cable, said operating means and said switch being so positioned that the operating means engages and operates the switch each time the cup tips to discharge its contents.

* * * * *